

CLAIMS

1. A composite material comprising an active solid and a phase change material, characterized in that:

5 - the phase change material takes the form of micronodules having an average size of between 1 micron and 5 millimeters;

 - the phase change material is selected from materials with a liquid/solid phase change temperature
10 of between -150°C and 900°C;

 - the active solid is selected from solids that can be used in a method involving reversible physicochemical processes that are exothermic in one direction and endothermic in the opposite direction.

15 2. The composite material as claimed in claim 1, characterized in that the active solid is a reactive solid that can be used in a reversible chemical reaction.

 3. The composite material as claimed in claim 2, characterized in that the reactive solid is selected
20 from halides, carbonates and hydroxides.

 4. The composite material as claimed in claim 1, characterized in that the active solid is a porous and/or microporous solid that can be used in a
25 reversible adsorption process.

 5. The composite material as claimed in claim 4, characterized in that the porous and/or microporous active solid is selected from activated charcoals, zeolites, activated alumina and silica gels.

30 6. The composite material as claimed in claim 1, characterized in that the phase change material is a paraffin or a mixture of paraffins.

 7. The composite material as claimed in claim 1, characterized in that the phase change material is a
35 congruent melting salt.

 8. The composite material as claimed in claim 7, characterized in that the congruent melting salt is selected from hydrated or unhydrated halides, hydrated

or unhydrated carbonates, hydrated or unhydrated sulfates, phosphates, nitrates and hydroxides.

9. The composite material as claimed in claim 8, characterized in that the congruent melting salt is
5 selected from CaBr_2 , CaCl_2 , KF , KCl , MgCl , NaCl , NaF , NH_4Cl , NH_4F , $\text{ZnCl}_2 \cdot 5\text{H}_2\text{O}$, $\text{KF} \cdot 4\text{H}_2\text{O}$, $\text{CaCl} \cdot 6\text{H}_2\text{O}$, $\text{LiClO}_3 \cdot 3\text{H}_2\text{O}$, MgSO_4 , ZnSO_4 , Na_2SO_4 , $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, $(\text{NH}_4)_2\text{SO}_4$, Na_2HPO_4 , NaH_2PO_4 , $\text{NH}_4\text{H}_2\text{PO}_4$, NH_4NO_3 , $\text{Al}(\text{NO}_3)_3$, $\text{Ca}(\text{NO}_3)_2$, $\text{Cd}(\text{NO}_3)_2$, KNO_3 , LiNO_3 , $\text{Mg}(\text{NO}_3)_2$, NaNO_3 , $\text{Ni}(\text{NO}_3)_2$, $\text{Zn}(\text{NO}_3)_2$,
10 $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Cu}(\text{NO}_3)_2$, $\text{Ba}(\text{OH})_2$ and NaOH .

10. The composite material as claimed in claim 1, characterized in that the phase change material is a metal.

11. The composite material as claimed in claim
15 10, characterized in that the metal is selected from Al , Pb , Cu , Zn and alloys thereof.

12. The composite material as claimed in claim 1, characterized in that the active solid takes the form of particles or monoliths.

20 13. The composite material as claimed in claim 1, characterized in that it comprises a porous or microporous active solid, in the form of monoliths or particles, the micronodules occupying the pores of the active solid.

25 14. The composite material as claimed in claim 1, characterized in that it is formed by mixing particles or monoliths of active solid and micronodules, the micronodules occupying the spaces between the particles or the monoliths of active solid.

30 15. The composite material as claimed in claim 1, characterized in that it comprises particles or monoliths of active solid on the surface of which the micronodules are fixed, either by chemical grafting or by bonding with an adhesive.

35 16. The composite material as claimed in claim 1, characterized in that it comprises particles of active solid fixed on the surface of the micronodules by chemical grafting or by bonding with an adhesive.

17. The composite material as claimed in claim 1, characterized in that it comprises a mixture of particles or monoliths of active solid, and particles of a support material on which the micronodules are fixed.

18. The composite material as claimed in claim 1, characterized in that it comprises one or a plurality of monoliths of active solid in which the micronodules are distributed.

19. The composite material as claimed in claim 1, characterized in that it further contains expanded natural graphite.

20. A method for controlling thermal effects in a reversible physicochemical process between an active solid and a gaseous compound, said process being exothermic in one direction and endothermic in the opposite direction, characterized in that the thermal effects are controlled by using a composite material as claimed in one of claims 1 to 19 as active solid.

21. A method for purifying a gas mixture by adsorption and regeneration by pressure modulation, called the PSA method, consisting in carrying out the successive steps of pressurization and depressurization of at least one adsorbent bed by a gas mixture, in order to separate the gas mixture, said method being characterized in that the adsorbent bed(s) comprise(s) a composite material as claimed in claim 1.

22. The method as claimed in claim 21, put into practice to obtain purified hydrogen from a gas mixture, characterized in that the gas mixture to be processed is a hydrogen-rich mixture further containing CO_2 and CH_4 , and in that said mixture passes successively through two adsorbent beds, the first comprising activated charcoal and micronodules of phase change material, the second comprising zeolite and micronodules of phase change material.

23. The method as claimed in claim 21, put into practice to dry air, characterized in that the gas

mixture to be processed is air containing water vapor and in that the adsorbent bed is a composite material comprising an alumina or a zeolite, and the micronodules are paraffin micronodules.

5 24. A method for storing gas by reversible adsorption on a porous solid, characterized in that the porous solid is a composite material as claimed in claim 4.

10 25. The method as claimed in claim 24, characterized in that the composite material comprises zeolite or activated charcoal.

15 26. A method for extracting oxygen from air by adsorption and regeneration by pressure modulation, called the VSA method, consisting in carrying out successive steps of pressurization by air and of placing an adsorbent bed under vacuum, characterized in that the adsorbent bed comprises a composite material as claimed in claim 1.

20 27. The method as claimed in claim 26, characterized in that said material comprises a zeolite and a paraffin with a phase change temperature close to 290K.